

REPORT

A/E/C Integration Workshop

Georgia Institute of Technology
Construction Resource Center

Updated:
July 6, 2007

Acknowledgements

The Construction Resource Center (CRC) at the Georgia Institute of Technology would like to acknowledge the invited panelists and their respective organizations for participating in this workshop, including: General Services Administration; Holder Construction; Draper and Associates; Lord, Aeck and Sargent; and the American Council of Engineering Companies. The CRC would also like to acknowledge the participating College of Architecture faculty and their respective academic departments for their time and input, as well as Civil Engineering Professor Larry Kahn for reviewing this report.

The CRC would also like to acknowledge Dr. Linda Thomas-Mobley for serving as moderator for this event, and Ms. Lisa Borello for coordinating the workshop and preparing the report.

Executive Recommendations

Globalization, increasing project complexity, and emerging technologies are among the major drivers affecting the Architecture, Engineering and Construction (A/E/C) industry¹. These changes are overtaking the A/E/C industry and are forcing formally fragmented groups to work together to create a more efficient, economic and sustainable product. The organizations that will move ahead in this climate understand and embrace these changes. More importantly, they are led by individuals who possess the skills and foresight needed to successfully meet these challenges and incorporate change.

The Georgia Institute of Technology is in a unique position to help meet the growing demand for professionals who can lead the A/E/C industry toward seamless integration and become innovators and change agents within the field. However, training students on basic management practices or new technologies alone isn't sufficient to prepare them for managing the diversity and complexities of the A/E/C workplace. Thus, a unique approach to A/E/C education is needed.

Based on the discussion and ideas generated from this workshop, an integrated curriculum should be central to the College of Architecture's core mission. An integrated curriculum trains and prepares students in two core areas: (1) cultural and organizational changes affecting the industry; and (2) the industry's current and future technological needs.

More specifically, a curriculum centered on A/E/C integration provides a foundation in:

- **Culture:** Refers to establishing a mindset based on teamwork, collaboration, and empathy for the differing roles and responsibilities of various stakeholders involved in the industry. An advanced knowledge of the processes and responsibilities of architects, engineers and builders will be essential in managing multi-disciplinary teams and complex projects. Having managers with the required technical skills plus expertise in business management, marketing, law, finance and accounting is a necessity within the integrated A/E/C workplace. Emphasis must also be placed on managing diverse educational, cultural and economic multi-disciplinary teams, particularly in an increasingly global workplace.
- **Technology:** Refers to the specific IT tools used in the A/E/C industry, such as Building Information Modeling (BIM). It also includes training in delivery systems, process management, telecommunications, shared work environments, and other innovations. However, rather than teaching a single technology or

¹ In this report, Planning is classified under the discipline of Architecture. The term A/E/C industry/integration/education is used throughout this report and includes the field of Planning.

software, students should have hands-on experience with various emerging technologies. The intent is not to train them on a single system or process, that may become outdated, but to arm them with the critical thinking and analytical skills that can be applied to various challenges they will encounter.

Providing training in these core competencies will produce graduates who can manage diverse teams, have the skills and mindset for effective integration and automation of project processes, have engineering, design and construction knowledge, and fundamental knowledge of information technology, management and financial principles. In short, this curriculum will produce professionals armed with the necessary skills to move the A/E/C industry forward.

There is also recognition that Engineering (“E”) education and emphasis is significantly missing from dialogue concerning integration. Future initiatives on the part of the College of Architecture are needed to begin a dialogue with representatives from the College of Engineering in order to develop a truly integrated curriculum.

Executive Summary

This report summarizes the results of an A/E/C Integration Workshop held at Georgia Institute of Technology by the Construction Resource Center on April 25, 2007.

The purpose of the workshop was to gain an understanding from industry professionals and academicians concerning Architecture, Engineering, Construction, and Planning (A/E/C) Integration. The workshop focused on a number of issues, such as the factors driving integration and those preventing the construction industry from achieving integration, as well as the types of tools or processes needed to enhance integration. The purpose of the workshop was to generate ideas that will help the College of Architecture create a curriculum centered on A/E/C integration.

A small number of experts from different sectors of the A/E/C industry, representing both the private and public sector, as well as academia, were invited to participate in the event. Panelists included representatives from: Holder Construction; Draper & Associates; General Services Administration; Georgia Tech; Lord, Aeck & Sargent; and the American Council of Engineering Companies. Faculty from Georgia Tech's College of Architecture (COA) also attended, and included representatives from the following academic programs and offices: Architecture; Building Construction; City and Regional Planning; PhD Program; and the Dean's Office.

The workshop was organized in four parts: Part I centered on defining integration; Part II focused on factors driving and preventing integration; Part III centered on the tools to enhance A/E/C Integration; and Part IV included a discussion on how universities can best respond to industry needs for A/E/C integration and the types of courses and issues that should be included in curricular study.

For each of the parts, participants were asked to answer a group of prepared questions from their professional perspective. At the conclusion of the fourth part, a round-table discussion was held.

In the first part, each member of the panel was asked to provide a definition of A/E/C integration. Definitions varied greatly depending on the professional background and perspective of the panelist. Panelists defined integration as: a 'Team Approach' to project execution; leadership and project/program management; either a 'Renaissance Man' master builder or a shared sense of empathy among disciplines; relationship-building; technology-based (BIM); and a reflection of industry trends toward consolidation.

In the second part, panelists provided both driving and preventing factors toward integration. Among the driving factors included: demands of market; client expectations; increasingly complex project; litigation; technology; and re-conceptualization of the meaning of 'value.' Some of the factors preventing the industry from achieving integration included: lack of trained personnel; attitudes of professionals; fragmentation of disciplines in university setting; lack of unifying standards; and fear of technology.

Panelists discussed the general tools that can be utilized to enhance integration in the third part of the workshop. Some of the items discussed included: innovations in procurement and project delivery systems; development of standardized processes; gathering industry feedback on their needs and concerns; and creating an educational environment in which integration is central to learning.

The fourth part included a discussion of the role of Georgia Tech, and other universities, in promoting A/E/C integration at the college level. Panelists discussed some of the core competencies which were critical for future graduates, including: financial and business skills; problem-solving skills; technical expertise; and more exposure to the various disciplines. Panelists also discussed some of the specific ways Georgia Tech can move toward a more integrated curriculum, including: development of jointly-taught courses; joint lecture series with College of Engineering; open dialogue with the College of Engineering on strategies for closer cooperation; and development of the first graduate degree for Professionals in the Built Environment (MBA, in partnership with College of Management).

This report includes a list of participants and a summary for each of the four parts. An overview of the College of Architecture's current efforts to promote integration is also provided in the report, as is a summary of key take-aways as discussed by COA faculty. The workshop agenda is also included.

The Construction Resource Center will plan to offer additional workshops on this topic in the future.

WORKSHOP PARTICIPANTS

Panel Members

Name	Title & Organization
Jeff Beard	Vice President and Institute for Business Management Director, American Council of Engineering Companies
Brian Bowen	Executive-in-residence, College of Architecture, Georgia Tech
Pat Jones	Managing Principal, Capital Programs Division, Draper & Associates
Mike Kenig	Vice Chairman, Holder Construction
Cobb Quarles	Associate, Lord, Aeck & Sargent
Richard Stephenson	Acting Deputy Assistant Regional Administrator for Real Estate, Design, Construction and Development, General Services Administration

Attending Georgia Tech Participants

Name	Title & Organization
Doug Allen	Interim Dean, College of Architecture
Fried Augenbroe	Associate Professor, PhD Program
Daniel Castro	Assistant Professor, Building Construction
Michael Dobbins	Associate Professor, City Planning
Chuck Eastman	Director, PhD Program
Roosbeh Kangari	Director, Construction Resource Center
Sabir Khan	Associate Dean, College of Architecture
Kathy Roper	Assistant Professor, Building Construction
Charles Rudolph	Associate Professor, Architecture
Saeid Sadri	Associate Professor, Building Construction
Linda Thomas-Mobley	Associate Professor, Building Construction
Lisa Borello	Research Coordinator, CRC/BC

PART I: DEFINING INTEGRATION

How does your organization define A/E/C Integration?

Private Sector/Construction (Holder)

- ‘Team Approach’
 - Each project requires collaboration and integration
 - All decisions are made in the best interest of the project; open information sharing
 - Involvement of all parties: Owner, contractor, trade contractors, etc.

Private Sector (Draper & Associates):

- Project/program management
 - Requires individuals who can provide project leadership
 - Have core competencies for AEC project: effect day-to-day project management; lead/manage project delivery and fulfill management objectives set out by owner
 - Must have IT platform as force to bring together multiple project teams; effective communication; data-gathering; remove geographic restrictions

International Sector/Academia (Hanscomb Limited/Georgia Institute of Technology):

- Integration ‘heavy’
 - Renaissance man – roll together all entities in industry into one person
- Integration ‘light’
 - Involves mutual empathy; partnering, collaboration, teamwork, make nice together
- ‘The Integrator’ [sole unifying person, force or technology]

Public Sector (General Services Administration):

- Integration is collaboration involving all stakeholders; involves building a relationship, in which everyone involved in the process on board early from the beginning
- Use of BIM as unifying technology

Private Sector/Architecture (Lord, Aeck & Sargent):

- Integration centered on modeling, CAD, technology, and BIM
- Procurement and delivery methods as integration
- Market drives level of integration and collaboration, and methodology

Professional Organization/Engineering (American Council of Engineering Companies):

- Movement from segregating in single discipline, to being multi-disciplinary and full-service
- Firm integration is reflection of industry integration

PART II: DRIVING & PREVENTING FACTORS

*What are the factors **driving** the construction industry toward integration?*

- Optimal value driving need for integration
- Global competition and pressure
- Owners objectives have expanded
- Projects are more complex and requires involvement of more trades and disciplines
- Client demands and needs have expanded; expect seamless delivery of product
- Value changes are taking place
 - speed and quality vs. first cost
 - sustainability
 - knowledge is more highly regarded
- Technology: can be viewed more as a facilitator than a driving integrator
- Litigation
- Industry consolidations
- Cost and resources limited, requires pooling together of resources and people
- Market forcing collaboration
- Owners are asking for integrated solutions
- Prospect of BIM allows for virtual collaboration and construction

*What factors are **preventing** the industry from achieving integration?*

- People “stuck”; traditional mindsets and ideas of roles and responsibilities
- Lack of industry standards
- Differing software, technology, vocabulary
- Technology is evolving and changing faster than people can adapt
- Organizational sluggishness and lack of leadership
- Inability to form human relationships as opposed to relying solely on technology
- Attitudes of players; animosity in industry begins at university level
- Professional and trade organization – no one single entity to represent the entire industry
- Increasing levels of specialization
- Widened fears of litigation (both driving and preventing)
- Fragmentation of building profession and separation of disciplines at university level
- Fear of technology
- Lack of skilled, trained workforce
- Initial cost of bringing technology and having make choice early on which to use
- Low bid systems – can set up adversarial relationships
- Institutional barriers; existing systems prevent integration (such as permitting system in cities and counties) and university systems

PART III: ENHANCING INTEGRATION

What are some of the tools that could enhance A/E/C Integration?

- Metrics to monitor value
- Value vs. Cost
- Innovative procurement
- Investing in human capital
- Team ‘chemistry’
- Listen to industry
- Benchmarking universities, looking nationally/internationally
- Advanced training in project management
- Standard processes
- Contract incentives
- BIM, 4D, CAD (offer laboratories in university setting)
- Partnering to build trust and relationships
- Improved software
- Industry-tested technologies
- Education (Common degree or professional organization; ex., PROBE: Professionals of the Built Environment)

PART IV: A/E/C EDUCATION

How should Georgia Tech respond to the needs for A/E/C integration?

If Georgia Tech develops a degree program centered on A/E/C integration, what subject matters and issues need to be addressed and included in the curriculum?

- Financial and business skills
- Joint-taught courses
- Remove silos between disciplines
- Shift attitudes and teach respect/understanding of other disciplines
- Introduce required course(s) on the construction industry at-large at both undergraduate and graduate levels
- Train students for future changes in industry and their own career trajectory
- Seek industry input on necessary skills and issues
- Joint graduate degrees (with engineering, management, etc.)
- Offer courses in historical industry studies
- Joint A/E/C lecture series with the College of Engineering
- Open dialogue with College of Engineering on strategies for closer cooperation
- Move toward one degree in built environment
- Team problem-solving course
- Leadership course
- Total cost of ownership course
- Current trends and technology course
- Design courses for constructors
- Look at the type of students entering the discipline
- Develop country's first MBA for Professionals in the Built Environment

College of Architecture: Viewpoint on Integration

Presented by Doug Allen, Interim Dean

The College of Architecture Strategic Plan (draft) includes priority emphasis on A/E/C Integration.

Integration dependant upon:

1. Collaboration: Extended understanding and empathy of value of various participants and stakeholders
2. Language: Create common language which is understood by architects, builders and owners; Software can be a form of language and communication

Existing COA Integration Efforts:

1. Common First Year (CFY): group of three courses all entering undergraduate students are required to take, which provides introduction to design and construction; students still have core competency in one discipline but are provided with the language and agility to move between disciplines
2. Big 12: Initiative started by Dean Tom Galloway which brings together 12 universities which house architecture and construction programs in the same college
3. Existing research projects among faculty and students
4. Development of new academic courses; course started by Brian Bowen in History of Construction has potential to grow

Future Efforts:

1. Development of College-wide Lecture Series
2. Dual-Degree Programs

Challenges:

1. Budget: state funding only covers 24% of budget, rest generated by research dollars
2. Research: COA needs to better position itself as producer research in national interests; some areas, such as sustainability, building performance and indoor air quality, are niche areas where COA may be able to gain access to research dollars.

**Wrap-Up Discussion:
Summary of Input and Key Take-Aways from COA Faculty**

- Need for both degree programs in integration and more partnering, training and collaboration among disciplines at undergraduate and graduate levels
- Need to teach students to view projects within wider environment and see the ecosystem of a project and multiple stakeholders
- Offer courses with semester-long activities that integrate the disciplines (urban planning, civil engineering, law, public policy, architecture, etc.); establish a culture of collaboration
- Provide students with a framework in which the interconnectedness of projects are explored and foster/promote integration
- University environment can serve as a hub of advancing innovation in BIM technology
- Be more creative in approaches to research and seek partnerships with multiple disciplines
- Provide more inter-disciplinary research opportunities for students
- University needs to do better job teaching respect for other disciplines; often students don't gain appreciation for other professions until they are out in the workforce
- Need to focus more on training students to be adaptable and flexible to better cope with changing industry
- Focus on teaching critical thinking skills as way to promote integration
- Future workshops on A/E/C Integration are needed
- College may want to consider working with NIST on developing a research center that involves multiple colleges and departments (building on work by Professor Chuck Eastman on developing new BIM technologies; Center to be headed by COA)

APPENDIX

**A/E/C Integration Workshop
Construction Resource Center
College of Architecture, Georgia Tech**

April 25, 2007

Georgia Tech Student Center, Room 321

Contact: Ms. Lisa Borello, Office: 404-894-2069 and Cell: 404-457-0277

Dear Workshop Participants:

We are looking forward to your participation in the upcoming A/E/C Integration Workshop, to be held on Georgia Tech's campus next week.

The event will be held on **Wednesday, April 25**, from **noon to 4:00 p.m.** in the Georgia Tech Student Center (Room 321).

Attached is a workshop agenda, list of confirmed participants and directions to Georgia Tech's Student Center. The workshop will be divided into four major topic areas; we are asking that the invited Panelists (as listed in the following tables) be prepared to speak informally for 5-7 minutes on each of the following topics. We will then open up the discussion to the entire group.

Part I: Defining Integration

How does your organization define A/E/C integration?

Part II: Driving & Preventing Factors

What are the factors driving the construction industry toward integration?

What factors are preventing the industry from achieving integration?

Part III: Enhancing Integration

What are some of the tools that could enhance A/E/C Integration?

Part IV: A/E/C Education

How should Georgia Tech respond to the needs for A/E/C Integration? If Georgia Tech develops a degree program centered on A/E/C integration, what subject matters and issues need to be addressed and included in the curriculum?

Please feel free to contact us if you have any questions or concerns. Thank you again for your willingness to participate in this important event.

Agenda

A/E/C Integration Workshop
Construction Resource Center
College of Architecture, Georgia Tech
April 25, 2007
Georgia Tech Student Center, Room 321

Noon	Lunch	
12:15 p.m.	Welcome and Introduction	Dean Doug Allen
12:20 p.m.	Objectives and Structure	Dr. Thomas-Mobley
12:30 p.m.	Part I: Defining Integration How does your organization define A/E/C integration?	Panel Members
1:15 p.m.	Part II: Driving & Preventing Factors What are the factors driving the construction industry toward integration? What factors are preventing the industry from achieving integration?	Panel Members
2:00 p.m.	Part III: Enhancing Integration What are some of the tools that could enhance A/E/C Integration?	Panel Members
2:45 p.m.	Part IV: A/E/C Education How should Georgia Tech respond to the needs for A/E/C Integration? If Georgia Tech develops a degree program centered on A/E/C integration, what subject matters and issues need to be addressed and included in the curriculum?	Panel Members
3:30 p.m.	Wrap-up Discussion	All Participants
3:50 p.m.	Closing Remarks	Dean Allen

A/E/C Integration Workshop, Georgia Tech
Panel Members

Name	Title & Organization	E-mail Address
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Brian Bowen	Executive-in-residence, College of Architecture, Georgia Tech	brian.bowen@coa.gatech.edu
Pat Jones	Managing Principal, Capital Programs Division, Draper & Associates	pjones@draperandassociates.com
Mike Kenig	Vice Chairman, Holder Construction	mkenig@holder.com
Cobb Quarles	Associate, Lord, Aeck & Sargent	cquarles@lasarchitect.com
Richard Stephenson	Acting Deputy Assistant Regional Administrator for Real Estate, Design, Construction and Development, General Services Administration	richard.stephenson@gsa.gov

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